

CLAIMS:

1. A copolymer formed by polymerizing propylene, 4-methyl-1-pentene, styrene, or another C₄₋₂₀ α-olefin, and a copolymerizable comonomer in the presence of a composition comprising the admixture or reaction product resulting from combining:
 - 5 (A) a first olefin polymerization catalyst,
 - (B) a second olefin polymerization catalyst capable of preparing polymers differing in chemical or physical properties from the polymer prepared by catalyst (A) under equivalent polymerization conditions, and
 - (C) a chain shuttling agent.
- 10 2. A copolymer formed by polymerizing propylene, 4-methyl-1-pentene, styrene, or another C₄₋₂₀ α-olefin, and a copolymerizable comonomer in the presence of a composition comprising the admixture or reaction product resulting from combining:
 - (A) a first olefin polymerization catalyst having a high comonomer incorporation index,
 - (B) a second olefin polymerization catalyst having a comonomer incorporation index less than 95 percent of the comonomer incorporation index of catalyst (A), and
 - (C) a chain shuttling agent.
- 15 3. A process for preparing a propylene containing multi-block copolymer comprising contacting propylene and one or more addition polymerizable comonomer other than propylene under addition polymerization conditions with a composition comprising:
 - 20 the admixture or reaction product resulting from combining:
 - (A) a first olefin polymerization catalyst,
 - (B) a second olefin polymerization catalyst capable of preparing polymers differing in chemical or physical properties from the polymer prepared by catalyst (A) under equivalent polymerization conditions, and
 - (C) a chain shuttling agent.
 - 25 4. A process according to claim 3 wherein the comonomer is ethylene.
 5. A process for preparing a 4-methyl-1-pentene containing multi-block copolymer comprising contacting 4-methyl-1-pentene and one or more addition polymerizable comonomers other than 4-methyl-1-pentene under addition polymerization conditions with a composition comprising:
 - 30 the admixture or reaction product resulting from combining:
 - (A) a first olefin polymerization catalyst,
 - (B) a second olefin polymerization catalyst capable of preparing polymers differing in chemical or physical properties from the polymer prepared by catalyst (A) under equivalent polymerization conditions, and

(C) a chain shuttling agent.

6. A process according to claim 5 wherein the comonomer is ethylene.

7. A multi-block copolymer comprising in polymerized form two monomers selected from the group consisting of C₂₋₂₀ α-olefins, said copolymer containing therein two or more segments or blocks differing in comonomer content, crystallinity, tacticity, homogeneity or density, and at least one of the polymer blocks consisting essentially of polymerized propylene, 4-methyl-1-pentene, styrene, or other C₄₋₂₀ α-olefin.

5 8. A multi-block copolymer comprising in polymerized form propylene and ethylene, or 4-methyl-1-pentene and ethylene, said copolymer containing therein two or more segments or blocks differing in comonomer content, crystallinity, tacticity, homogeneity or density.

10 9. A multi-block copolymer consisting essentially of propylene and ethylene or 4-methyl-1-pentene and ethylene in polymerized form, said copolymer containing therein two or more segments or blocks differing in comonomer content, crystallinity, tacticity, homogeneity or density.

15 10. A multi-block copolymer according to any one of claims 5-9 containing therein four or more segments or blocks differing in comonomer content, crystallinity, tacticity, homogeneity, or density.

11. A functionalized derivative of the multi-block copolymer of any one of claims 1, 2, 5-9 or made by the process of claim 3 or 4.

12. A functionalized derivative of the multi-block copolymer of claim 10.

20 13. A homogeneous polymer mixture comprising: (1) an organic or inorganic polymer and (2) a multi-block copolymer according to any one of claims 1, 2, 5-9 or made by the process of claim 3 or 4 of the present invention.

14. A crosslinked derivative of a polymer according to any one of claims 1, 2, 5-9 or made by the process of claim 3 or 4.

25 15. A crosslinked derivative of a polymer according to claim 10.

16. A crosslinked derivative of a polymer according to claim 11.

17. A crosslinked derivative of a polymer according to claim 12.

30 18. A polymer according to any one of claims 1, 2, 5-9 or made by the process of claim 3 or 4, or a composition comprising the same in the form of a film, at least one layer of a multilayer film, at least one layer of a laminated article, a foamed article, a fiber, a nonwoven fabric, an injection molded article, a blow molded article, a roto-molded article, or an adhesive.

35 19. A polymer according to claim 14 or a composition comprising the same in the form of a film, at least one layer of a multilayer film, at least one layer of a laminated article, a foamed article, a fiber, a nonwoven fabric, an injection molded article, a blow molded article, a roto-molded article, or an adhesive.

20. A polymer according to claim 15 or a composition comprising the same in the form of a film, at least one layer of a multilayer film, at least one layer of a laminated article, a foamed article, a fiber, a nonwoven fabric, an injection molded article, a blow molded article, a roto-molded article, or an adhesive.

5 21. A polymer according to claim 16 or a composition comprising the same in the form of a film, at least one layer of a multilayer film, at least one layer of a laminated article, a foamed article, a fiber, a nonwoven fabric, an injection molded article, a blow molded article, a roto-molded article, or an adhesive.

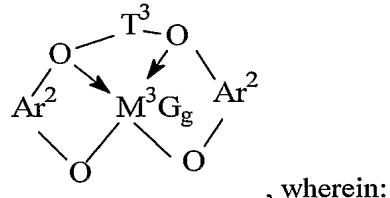
10 22. A polymer according to claim 17 or a composition comprising the same in the form of a film, at least one layer of a multilayer film, at least one layer of a laminated article, a foamed article, a fiber, a nonwoven fabric, an injection molded article, a blow molded article, a roto-molded article, or an adhesive.

15 23. A copolymer according to claim 1 or 2 wherein the shuttling agent is a trihydrocarbyl aluminum- or dihydrocarbyl zinc- compound containing from 1 to 12 carbons in each hydrocarbyl group.

24. A copolymer according to claim 23 wherein the shuttling agent is triethylaluminum or diethylzinc.

20 25. A copolymer according to claim 1 or 2 wherein catalyst (A) comprises a complex comprising a transition metal selected from Groups 4-8 of the Periodic Table of the Elements and one or more delocalized, π -bonded ligands or polyvalent Lewis base ligands.

26. A copolymer according to claim 25 wherein catalyst (A) corresponds to the formula:



, wherein:

T^3 is a divalent bridging group of from 2 to 20 atoms not counting hydrogen; and

Ar^2 independently each occurrence is an arylene or an alkyl- or aryl-substituted arylene

25 group of from 6 to 20 atoms not counting hydrogen;

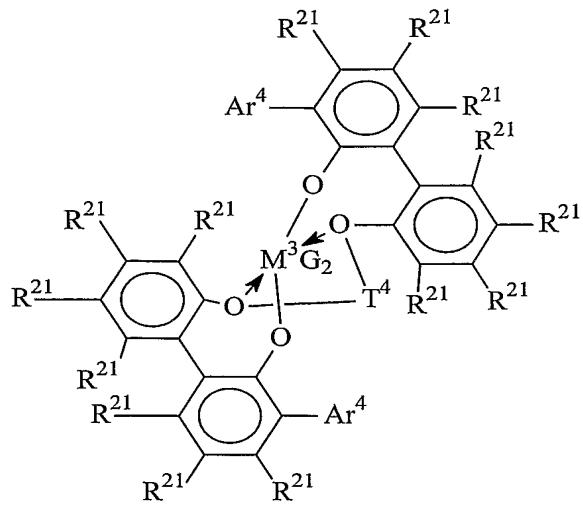
M^3 is a Group 4 metal;

G independently each occurrence is an anionic, neutral or dianionic ligand group;

g is a number from 1 to 5 indicating the number of such X groups; and

electron donative interactions are represented by arrows.

30 27. A copolymer according to claim 23 wherein catalyst (A) corresponds to the formula:



wherein M^3 is Hf or Zr;

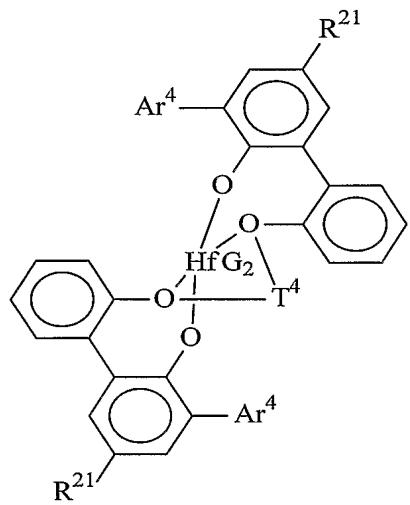
Ar^4 is C_{6-20} aryl or inertly substituted derivatives thereof, especially 3,5-di(isopropyl)phenyl, 3,5-di(isobutyl)phenyl, dibenzo-1H-pyrrole-1-yl, or anthracen-5-yl, and

5 T^4 independently each occurrence comprises a C_{3-6} alkylene group, a C_{3-6} cycloalkylene group, or an inertly substituted derivative thereof;

R^{21} independently each occurrence is hydrogen, halo, hydrocarbyl, trihydrocarbylsilyl, or trihydrocarbylsilylhydrocarbyl of up to 50 atoms not counting hydrogen; and

10 G , independently each occurrence is halo or a hydrocarbyl or trihydrocarbylsilyl group of up to 20 atoms not counting hydrogen, or 2 G groups together are a divalent derivative of the foregoing hydrocarbyl or trihydrocarbylsilyl groups.

28. A copolymer according to claim 23 wherein catalyst (A) corresponds to the formula:



wherein Ar^4 is 3,5-di(isopropyl)phenyl, 3,5-di(isobutyl)phenyl, dibenzo-1H-pyrrole-1-yl, or

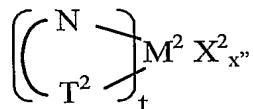
15 anthracen-5-yl,

R²¹ is hydrogen, halo, or C₁₋₄ alkyl, especially methyl

T⁴ is propan-1,3-diyl or butan-1,4-diyl, and

G is chloro, methyl or benzyl.

29. A copolymer according to claim 1 or 2 wherein catalyst (B) corresponds to the formula:



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wherein

M² is a metal of Groups 4-10 of the Periodic Table of the elements;

T² is a nitrogen, oxygen or phosphorus containing group;

X² is halo, hydrocarbyl, or hydrocarbyloxy;

10 t is one or two;

x'' is a number selected to provide charge balance;

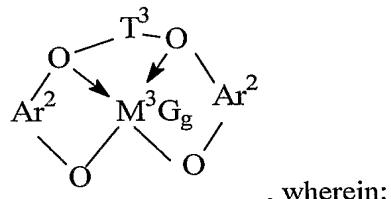
and T² and N are linked by a bridging ligand.

30. A process according to claim 3 or 4 which is a continuous process.

31. A process according to claim 30 which is a solution process.

15 32. A process according to claim 30 wherein propylene and ethylene or 4-methyl-1-pentene and ethylene are polymerized.

33. A process according to claim 30 wherein catalyst (A) corresponds to the formula:



, wherein:

T³ is a divalent bridging group of from 2 to 20 atoms not counting hydrogen; and

20 Ar² independently each occurrence is an arylene or an alkyl- or aryl-substituted arylene group of from 6 to 20 atoms not counting hydrogen;

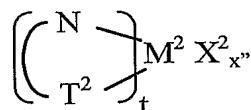
M³ is a Group 4 metal;

G independently each occurrence is an anionic, neutral or dianionic ligand group;

g is a number from 1 to 5 indicating the number of such X groups; and

25 electron donative interactions are represented by arrows.

34. A process according to claim 30 wherein catalyst (B) corresponds to the formula:



wherein

M^2 is a metal of Groups 4-10 of the Periodic Table of the elements;

T^2 is a nitrogen, oxygen or phosphorus containing group;

X^2 is halo, hydrocarbyl, or hydrocarbyloxy;

t is one or two;

x" is a number selected to provide charge balance;

and T^2 and N are linked by a bridging ligand.

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